

SOME SURGICAL CONDITIONS IN THE KNEE-JOINT.

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At the 1906 meeting of the American Medical Association some speakers whose enthusiasm and success in other operative lines is above question, expressed themselves as against operative repair of patellar fractures and this probably describes their attitude towards all knee-joint operations of choice. While this hesitation must be the result of their own observation, it does not seem to the writer to be justified by the best results obtainable.

There are three possible dangers in knee-joint operating—to life, to limb and to function.

The danger to life is small. In my paper in the *ANNALS OF SURGERY* for July, 1904, I found 297 recorded personal operations in the previous nine years on clean knees without a death. From the combined reports of the Massachusetts General and the Boston City Hospital covering the ten years preceding 1907 I find that 487 presumably clean knee-joints were opened with three deaths from sepsis, one from cerebral hemorrhage, and one from delirium tremens. There is a death-risk in all surgery, but since the complete section of all ligaments and exposure of the entire joint-surface has been practiced in septic conditions, I think the mortality will run lower than for the simpler aseptic abdominal operations. There should be practically no mortality.

The risk to limb has also been nearly eliminated by the operation referred to above. Amputations are reported less and less, and if the complete drainage-operation be done early enough an amputation should never be required. No amputations were performed in my previous list of operations. I have found one recorded since that list was made up.

The possibility of more or less loss of function remains to be considered. Permanent disability after operation on a clean joint almost without exception indicates adhesions within the joint. If adhesions could be prevented we should always get good functional joints, provided our diagnosis and treatment were correct.

I have dissected three joints showing fibrous ankylosis—one tubercular and the other two old cases probably not tubercular, but infection unknown. There was no adhesion of articular cartilage to articular cartilage in any of them, there was adhesion of a semilunar to the femur over an area of a half centimetre in diameter in one of them, and in every possible place there was adhesion of synovial membrane to synovial membrane in all of them. This suggests that in the knee-joint we can compare the adhesion problem with the same problem which has been much more studied in abdominal conditions in spite of the fact that there are both chemical and mechanical differences between the great synovial and the greater serous cavity.

The abdominal cavity is lined with serous membrane which is provided with stomata against constantly moving muscles which act as natural drainage pumps. Some parts of the walls and probably of the abdominal contents are always in motion, in spite of which we may find pus confined to a very small area. In the abdomen there are innumerable thin-walled blood-vessels which can play their osmotic part in the removal of fluid.

The knee-joint is lined with synovial membrane which secretes a thick lubricating fluid. No suction apparatus independent of ordinary joint-motion has been demonstrated, and there is no extensive system of thin-walled blood-vessels. Moreover an infection confined to one part of the cavity does not seem possible.

Clinical experience shows that the two cavities react to trauma and to some infections quite differently. We never see the abdomen fill up with serum as a result of a contusion

or aseptic laparotomy, while we have all seen knee-joints distended from similar causes.

Outside of miliary tuberculosis, portal obstruction, chylous ascites, certain cancers, and conditions producing general dropsy we know of no cause which will keep the abdomen distended with fluid for weeks, but blood has been found in a knee ninety-eight days after injury and gonorrhœal infection may keep a knee more or less distended for months. Under some conditions this may be an advantage. Suppose a case like those mentioned in the part on "Pads." After a tab is caught and partially crushed, the synovial fluid is poured out freely, the capsule is stretched and the tab is pulled out from between the bones.

It is not at all uncommon for patients to say that their knee works better when it is swelled, but such knees are continually getting into trouble until the surgeon or rarely some extra violence removes the offending tab and then the trouble is over. In any case the "water on the knee" which is often blood—the "chronic synovitis" the "subacute rheumatism" or whatever it may be called is almost always a symptom of some mechanical damage within the joint, and demands a real and accurate diagnosis by which only can we apply rational and appropriate treatment.

If we accept the conclusion that the natural drainage of the knee is so much inferior to that of the abdomen particularly when we follow the conventional treatment and immobilize the joint, it seems possible that we can improve results in aseptic knee-joint operations by providing for escape of the excess of joint-fluid for a few hours and by allowing as much motion as safety from bleeding and security of the sutures will permit. In septic conditions there is no longer any argument as to the desirability of opening, washing and draining freely, but I believe we should go further. There is never perfect rest in the abdomen. Walls or contents are always in motion so long as breathing lasts. Why then should we strive for perfect immobility and continuous contact of inflamed surfaces in

septic conditions of the knee unless we are deliberately trying to get ankylosis?

I believe that there will be fewer cases of ankylosis after operation on septic knees when we learn and insist on the proper amount of movement during the drainage and convalescent stage.

My preference is to use nothing stiffer than a hair pillow splint after operation and trust to the slight involuntary movements of the patient for preventing adhesions. If a splint be used the surgeon can break up the soft adhesions in twenty-four hours and every day thereafter by ten or fifteen degrees of passive motion.

Sepsis after operation will almost always leave some limitation of motion, but if knee-joint sepsis is not too severe to recover through incision and drainage we ought to begin motion early enough and persist until we have gained all possible for the patient. Drainage should be kept up until pure yellow synovia appears and motion should be started before the drain is removed, if as usual the joint is immobilized. Such limitation of motion as comes from infiltration and stiffness of the fibrous capsule can be taken care of later but adhesions gain strength the longer they are undisturbed.

The most essential element in avoiding infection is of course asepsis. Sterile gloves, instruments, sutures and dry-goods are demanded and provided for almost all operative work, but a sterile operative field is even more important in knee-joint work than in other locations where nature can take care of a certain amount of infectious material.

We can open an abdomen in an emergency with no more preparation of the skin than is possible on the operating table and with confidence in the result so far as the incision is concerned, but the knee is a different proposition. The skin over the knee is smooth in complete flexion, but is folded into fine wrinkles in extension, and the razor and scrubbing brush cannot remove the surface epithelium so well if preparation be done with extended knee as they can on a smooth abdominal wall or a flexed knee.

On most persons the skin over the knee is more exposed to dirt, cleanses itself less by perspiration, and receives less scrubbing with soap and water than the skin over the abdomen.

With these facts in mind I shave and scrub my knee-joints while flexed and then allow three days of antiseptic wet dressings before the final soap and alcohol preparation on the table. On my last three knees I have used an exceedingly weak solution of chlorinated soda—so weak as to cause no smarting and to give a barely perceptible odor of chlorine, with entire satisfaction.

FRACTURE OF THE PATELLA.

After fracture of the patella there must be blood in the joint. Blood in the knee is always slow to disappear and with prolonged immobility may help to form undesirable adhesions. This blood can all be removed at operation. The desirability of removing bony fragments so that they may not interfere with joint-action later needs no argument.

Studies on the healing of abdominal wounds where there is accurate coaptation of tendon to tendon but where immobilization is impossible and where there must have been intermittent traction across the suture line, show dense new connective tissue at the end of two weeks.

Surely the tendon of the quadriceps kept still will be no slower in healing and passive motion ought to be safe and desirable much sooner with accurate coaptation of the torn edges of the tendon than in a case where the intervening space must be bridged across through blood-clot by the fibrillæ growing from the severed ends. This means absence of permanent adhesions, for adhesions gain in strength as does the sutured tendon, and a patient will easily endure their rupture at the end of a day or two, when he would require an anæsthetic, bleed more, and very likely reproduce them because of the pain on voluntary motion at the end of four or six weeks.

Tension on the sutures is very slight unless the fracture be old and fragments widely separated, but if a knee is sewed up without drainage there may be tension from an excess of synovia poured out after the washing and the secondary

FIG. 1.



Five months after fracture and suture of patella, with chronic catgut.

trauma. In some cases this will produce the same sort of pull on the sutures that distention of the intestines produces after a laparotomy. It is only necessary to leave in a twisted silk-worm gut drain for a few days to avoid this, which is a real discomfort to the patient and a slight risk to the sutures. No infection from a properly prepared skin and dressing will travel up against the constant outflow of the first three days.

Absorbable sutures seem to be used almost universally now, and to my mind they are the only ones to be considered. The ultimate strength of the tendon depends on its reproducing its own tissues and any suture-material remaining at the end of four or six weeks is only a foreign body—useless if not a nuisance.

The complete restoration of the patella is of less importance than careful coaptation and suture of the aponeurosis on either side and any fragment of bone which cannot be held in place by sewing through its periosteum may as well be removed. It may do harm by furnishing a rough posterior surface to the patella while its absence is of no great consequence.

From the same sources before referred to I have collected the cases of fractured patella from 1897 on. There have been 378 cases of which thirteen were compound. Of these 195 were wired or sutured with five deaths of which three were operative. There were two deaths among the cases not operated. It is interesting to note that in 1897 16 per cent. were sutured in some fashion and in 1906, 60 per cent. Apparently all patellæ operated were wired previous to 1899, and in 1906 there were more than three sutured to one wired.

The accompanying X-ray (Fig. 1) taken five months after suture of aponeurosis and patella with chromicized cat-gut, the patellar sutures being passed mattress fashion through the aponeurosis over the patella, shows conclusively that neither drill, wire nor silk are needed for a perfect result. The patient, G. L. G., 26, female, ruptured her left patella and aponeurosis February 21, 1906. Five days later, after three days of preparation at her home and assisted by her

physician, Dr. J. H. Costello, the joint was opened, clots washed out, and the suturing was completed as above-described with silkworm gut drainage. Three days later the joint was moved for the first time, in six days a light plaster was applied and the patient got out of bed. Her recovery was uneventful in every way.

INFRA- AND SUPRAPATELLAR PADS.

There are certainly two types of patients who present themselves with disability due to hypertrophy of these structures. The most common type in my experience is usually a woman and almost always fat. Almost every physician recalls the dissecting-room subject with the thick layer of subcutaneous fat, fat about the nerve and vessel trunks, fat between and within the muscles, and fat even within the bones themselves. In the knee-joints of such specimens are found exceedingly well-developed fat-pads both above and below the patella and almost invariably their edges will show a degree of fringing which indicates mechanical damage. Many patients with such structures come to us complaining of sore knees and disability particularly on stairs. They suffer from a vicious circle of their own—they are fat and walking is uncomfortable, therefore they do not walk and therefore they become more fat and walking is increasingly difficult. They are not patients who easily consent to operation nor are they always desirable risks.

In my hands baking has given no permanent and little temporary relief to such patients. Massage has been a little more useful. Bandages and elastic knee-caps have restricted the movements of the joint and thereby diminished the passive pain and some of the pain on motion for a time.

These tabs may be found as I have before stated, connected with the suprapatellar fat-pad and catching between patella and femur or connected with the infrapatellar pad and catching between femur and patella or femur and tibia according to their attachment to the upper or posterior part of the pad. As a temporary relief to these patients I have found firm pressure by adhesive straps to be sometimes useful.

FIG. 2.

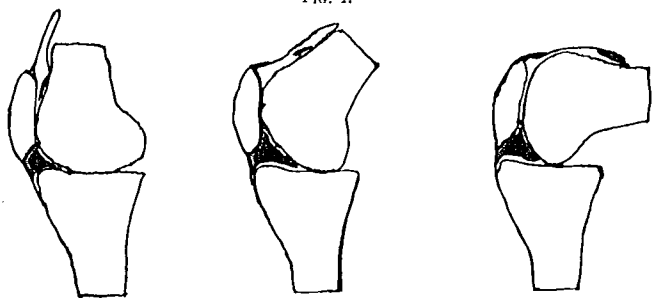


Diagram showing the relation of the supra- and intrapatellar pads to the bones in different positions.

If the offending tab be catching between patella and femur the pressure should come below the patella. If the tab catch between the femur and tibia the straps to give any relief should be applied so as to compress the capsule above the patella, but relief is less certain with tabs in this location.

If the patient can be made to lose flesh either by diet or by thyroid feeding the symptoms will sometimes disappear probably because the intra-articular masses shrink as fat is absorbed from the rest of the body.

An example of this type of patient was T. P. A., 39 years old, seen in 1904. In ten years of married life her weight had increased fifty pounds. Formerly athletic, she had given up all out-door sports, and complained bitterly of the pain caused by active extension of both knees. In extension the infrapatellar pad caused a decided prominence on either side of the patellar tendon and was tender to external pressure. There was no history of any injury to or snapping within the joint, but with slow passive extension pain could be produced and the characteristic crushing sensation felt. Under thyroid feeding, she lost sixteen pounds in four months and the disability in her knees at the same time. She has kept her weight down and now plays tennis and goes up and down stairs with comfort. The external tenderness is seldom present, though there is more than normal prominence over the infrapatellar pad. Some day she may require operation, but so far she has done very well without it.

The other type of patient is often young, in good physical condition and frequently athletic. I do not know how early these tabs may begin to cause trouble, though I have seen them from twelve years on. In such individuals I think any temporizing measures a waste of time if the patient will consent to operation. The tab is probably fibrous and growing more solid with every healing after being hurt. There is increasing possibility of its throwing its owner down in some unpleasant situation, and the recurring periods of disability mean much compared with the few days of convalescence from the slight operation required for removal. To show the sim-

plicity of the diagnosis and operation I have selected two cases:

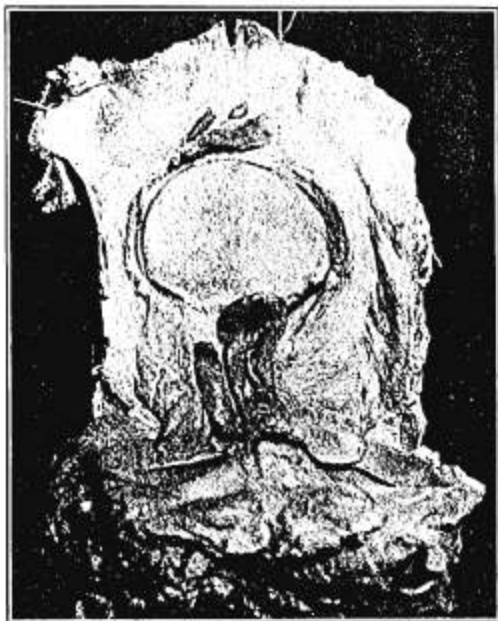
The first, H. C. W., 22, male, student. He was an athlete preferring long-distance runs. He was seen in February, 1906, in Dr. A. M. Cleghorn's office with a swollen and painful knee which had annoyed him twice before after a long walk. He was conscious of something catching at times, more often when going down stairs, and passive flexion with pressure on pad and patella produced a characteristic slight snap.

His joint was opened at the Stillman Infirmary February 11, and a thick, slightly-fringed pad was removed from the upper part of the infrapatellar pad. The incision was closed except for a silkworm gut bundle at the lower end of the wound, which was removed in five days, when his knee was first moved. His splint was removed on the tenth day, he left the hospital on the seventeenth day, and walked into my office with a cane on the twenty-third day with very little enlargement of the operated side, and approximately 120 degrees of flexion. During the summer of 1906 he rode a trotting horse, swam, played tennis, danced and walked without any discomfort in the knee. This tab was removed before the rest of the joint had become in any way damaged, and there is no reason to think that this knee will give him any further trouble.

Another case is Mrs. D. B. R., who had been on crutches most of the time for fifteen months, and had tried every palliative thing that could be suggested even to the actual cauterization on the skin over the pad. Tabs were present in both knees. One knee was operated December 6 and the other December 18, 1907, at the Boothby Hospital. Both joints were drained, no splint except hair pillow was used, and she went home on Christmas day. She gave up crutches within ten days and began to travel over the stairs. In February she went skating, and was free of all discomfort though her muscles had not fully recovered from their long disuse.

Figs. 3 and 4 reproduced from my previous article show two varieties of these disabling structures. The one shown in Fig. 3 will produce a snap as it slips from between patella and femur, while the one in Fig. 4 will give the crushing sensa-

FIG. 3.



Solid tabs from infrapatellar pad.

FIG. 4.



Fringed tab from infrapatellar pad.

FIG. 5.



Microphotograph of tab from infrapatellar pad. Case II.

tion and be more constantly painful. A cross-section of one of these fibrous tabs is shown in Fig. 5. Here the loss of synovial covering over one surface, probably femoral, the presence of numerous vessels near the surface and the complete replacement of the normal fat and areolar tissue by dense connective tissue are well shown.

Acute External Dislocation of the Patella.—This injury was discussed anatomically in my previous paper but at that time I did not realize the part which muscular violence plays in producing it.

J. R., 21, student, was wrestling with a 200-pound friend when his left knee suddenly gave out with some pain. He noticed his patella on edge at the outer side of the joint, and while his friends were pulling his leg he pushed the bone back into place. The leg was put on a ham-splint, and I saw him within a few hours. There was no ecchymosis, very little swelling of the joint, and no great tenderness. A depression could be felt at the inner side of the patella.

Dr. E. A. Codman saw him with me and agreed as to the desirability of operative repair. December 17, 1906, at the Stillman Infirmary, the joint was opened through a vertical incision internal to the patella. The skin and superficial fascia were the only protection to the joint. The internal patellar ligament, the insertion of the lower portion of the vastus internus, and in fact, everything that makes up the capsule was torn from the inner side of the patella and its tendon, and the lower part of the vastus was split horizontally from the rest of the muscle. The capsular rent was therefore about five inches long, and the separation an inch and a half. Incidentally the rent had torn away the inner side of the prepatellar bursa opening this into the joint-cavity. No difficulty arose in suturing the parts back into place, a silk-worm gut drain was left in, and he was put to bed with a ham-splint. One of the skin sutures caused a little annoyance but otherwise his convalescence was uneventful. He left the hospital on the eighteenth day with 80 degrees of painless motion. One month later he had given up his cane and enjoyed dancing a whole evening, and on February 19 there was no limp, very little thickening anywhere about the joint, and painless flexion of over 130 degrees.

So far as I know there is no published record of immediate repair of this injury. Two acute cases have been dissected and described—one at autopsy, and the other after amputation of the otherwise injured thigh. In no text-book is immediate repair even suggested as far as I have gone through them, and yet such repair as takes place without suture leaves the joint particularly liable to recurrence of the accident. In fact nature's repair of the condition as I saw it and as before described might leave a man more disabled than nature's repair of the torn patella and aponeurosis.

I am confident that no surgeon who realized the degree of separation and length of scar-tissue required to fill in the gap would allow a patient to recover with such a deficiency and probable recurring trouble if conditions were suitable for operating. The annoyance of the slipping patella is well known.

Bursæ.—Many bursæ give no symptoms whatever and produce no deformity to cause their owners uneasiness. The worst that can come from leaving such undisturbed is an increase in size with corresponding discomfort or æsthetic annoyance to the patient. The most common bursa to be shown the surgeon is the prepatellar. It may be dissected out and removed entire. This can be done with cocaine, but would not be done on me without general anæsthesia. A certain amount of rest would seem desirable until the raw surfaces lose their sensitiveness.

I have treated eighteen by stabbing them at their lowest point, cutting upwards until the hole will admit a cotton swab in a pair of snaps, pressing out all the fluid and fibrin masses, scrubbing the interior thoroughly with a carbolic acid swab, and leaving in a bundle of sterilized silkworm gut for a drain. If the drain is not used I do not think the result is certain for the sac usually fills again. With the drain left in until nature treats it as a foreign body, I have always been successful in abolishing the sac. If the skin be cocaineized before the stab the rest is almost painless, and immediately after the patient can walk and work, except kneeling, with comfort.

Complete obliteration may take three or four weeks, but usually about ten days.

The prepatellar bursa never communicates with the joint-cavity except that also be distended with fluid and this condition I have seen but once, and then after an acute external dislocation of the patella. The bursal sac is single and never lobulated to a degree that prevents a free scrubbing of its whole interior. For this reason it is well adapted to the treatment suggested, which is not recommended for any other bursa about the joint.

There is no other bursa about the knee except the one under the patellar tendon which does not at some time communicate with the joint-cavity. Consequently I prefer to dissect out all other bursæ.

These appear in various situations external to the fibrous capsule, and sometimes seem like hernias of the synovial lining. They are painless unless inflamed or pressing on some nerve, though they are often inconvenient. It is a help in determining whether a bursal sac communicates with the joint to remember that the capacity of the joint itself is greatest in 30 degrees flexion, much less in extreme extension, and least in extreme flexion. Therefore a sac flaccid at 30 degrees flexion and tense in the extreme positions differs from one of equal tension in all positions in being probably an extension of the joint-cavity.

It is hardly worth while to give a case to illustrate the treatment of housemaids' knees. They are alike except that the old cases containing fibrin masses are slower in healing than those which still contain some blood or blood-clot. There is always some redness and throbbing and usually a little purulent discharge before the healing is complete.

A case of *enlarged bursa about the biceps insertion* was G. P. W., 39, male. Symptom: Pain in course of left external popliteal nerve. History: For about ten months he had noticed a swelling on outer side of left knee. Examination: Swelling anterior to and just below the long insertion of the biceps cruris,

movable, tense in all positions, but containing fluid. June 11, 1904, this was dissected out at the Boothby Hospital. It was lobulated, one portion resting directly on the external popliteal nerve, and had become shut off from the general joint-cavity, though its former connection was still apparent as a funnel-shaped depression. He went home the third day and into the woods a week later for his usual vacation.

Dislocation of the Semilunar Cartilages.—Though I have seen a large number of cases of internal derangement of the knee-joint, there have been comparatively few which have seemed to me to be injuries of the semilunar cartilages, and of these I have operated but one.

What has seemed to me important in reviewing the notes of my paper of 1904 is that the over-riding of the internal semilunar by the femur has so small a place in operation reports. On the other hand, tears of the internal semilunar between its anterior attachment and its attachment to the internal lateral ligament are often reported by operators. The reason for this is to be found in the fact that any mechanical interference with extension of the knee leads to greater disability and causes more pain than an equal interference with flexion.

To carry weight on a fully extended knee requires no muscular effort compared with that required if the knee be flexed, and abnormal muscular exertion brings noticeable fatigue if not actual pain. Therefore the surgeon is sought for relief. Further as our usual incisions do not disclose the posterior part of the cartilage, posterior injuries may be overlooked. Some further experiments on cadaveric knees have carried out the conclusions previously arrived at as to the results of rotation of the leg after section of the internal lateral ligament between its attachments to the internal semilunar and the *femur*. There is always increase in lateral motion and external rotation and the back portion of the cartilage can be caught between femur and tibia.

If, on the other hand, the ligament be cut between its attachments to the semilunar and the *tibia* there is less increase in lateral motion and rotation, but with external rotation there

FIG. 6.



Spiral adhesive dressing. The two dots indicate the two ends of the internal lateral ligament.

is very marked tension on the fore part of the semilunar which draws the cartilage into the space between femur and tibia. If in life while this space is obliterated by body-weight the same sequence of events occurs, rupture of internal lateral ligament below semilunar and forcible external rotation of the weight-bearing foot, it is extremely probable that the semilunar will give way at its weakest part which is its anterior attachment, or between this and its middle. The consequent limitation of motion and its complete cure by operation is well known and calls for no discussion.

I wish to emphasize the connection between ligamentous and semilunar injuries, because damage to the lateral ligaments is a very common injury often concealed under the name of "sprain" or "acute synovitis," and because proper diagnosis and treatment of injuries to the lateral ligaments are essential not only for the present comfort of the patient, but to prevent misfortune later when the violence may be less and the consequent disability greater by reason of rupture or dislocation of a semilunar.

Diagnosis of injury to the ligaments is easy in most fresh cases on account of the sharply localized tenderness over one or both bony attachments. In more severe cases where there has been complete avulsion and the joint is filled with blood there is a noticeable increase in lateral motion and external rotation, both of which are painful even after months.

Treatment of this condition should vary with the severity of the injury. With the slightest degree of damage as estimated by the increase in movement before described, the essential thing is to take strain off the ligament by keeping the knee in internal rotation and slight flexion. This can be done by a Schaeffer splint better than by any other apparatus known to me, but properly applied adhesive strips serve nearly as well, are always at hand, and require no fitting. The accompanying photograph shows an arrangement which I have used with satisfaction for the past five years.

If the injury to the ligament be fresh and severe enough to increase the lateral and torsion movements decidedly, I fully

believe that the obligation to open and repair damage is greater than with fractured patella. In both cases there is blood in the joint-cavity which will favor adhesions, and in both cases the torn surfaces are separated by blood-clot and ragged weak tissue. Nature's coaptation and repair of a ruptured lateral ligament is likely to leave the patient more of a cripple than the longest sort of a "fibrous union" patella.

The few patients with fully ruptured lateral ligaments whom I have seen some years after their injury and conventional treatment with plaster cast and massage were either on crutches or "getting along" with some sort of splint apparatus. Their condition might be worse, but to-day they ought to fare better by reason of accurate diagnosis and careful coaptation and suture.

CONCLUSION.

1. Asepsis and drainage are more essential in knee-joint work than in laparotomies because of the difference in the skin of the operative fields and in the natural drainage of the two cavities.

2. Sepsis and immobility mean ankylosis. Drainage and mobility may leave some motion.

3. There is an increasing tendency towards operative repair of patellar fractures and an increasing use of absorbable material. This should be the rule to which exceptions may sometimes occur.

4. By far the most common mechanical cause of trouble within the joint is the tab from the infrapatellar pad. This may be a part of a general obesity in which case the usual anti-fat treatments are appropriate. If it be found in a vigorous and otherwise normal person it should be removed. Some temporary relief may be obtained by properly applied adhesive straps, but a cure only by removal.

5. Prepatellar bursitis can be cured by incision and drainage. Other bursæ should be dissected and removed.

6. Ligamentous injuries must be carefully treated and some must have operative repair to prevent recurring or constant disability. No apparatus is so good as a normal knee.